PUBLIC SAFETY PSWN PROGRAM WIRELESS NETWORK

Saving Lives and Property Through Improved Interoperability

A Progress Report on Public Safety Spectrum

Final

November 2001

FOREWORD

This report takes a diagnostic look at the progress made since the publication of the *Public Safety Wireless Advisory Committee* (PSWAC) Report in September 1996. It examines six previously identified spectrum issues highlighted in the *Public Safety Spectrum Issues and Analysis Report* in December 1999 that are seen as impediments to effective, interoperable communications:

- The aggregate amount of spectrum allocated for public safety is insufficient to meet current and future voice and data communications needs.
- Public safety spectrum allocations are fragmented throughout the very high frequency (VHF) and ultra high frequency (UHF) bands.
- To date, insufficient spectrum has been dedicated to meeting interoperability requirements.
- Affordable multiband technology is not readily available to the public safety community.
- The regulations and procedures used by the Federal Communications Commission and the National Telecommunications and Information Administration to manage spectrum are not always well understood and have not necessarily been designed to encourage and enable interoperability.
- As public safety spectrum issues are resolved and additional spectrum is made available, the public safety community must take care to migrate its operations to a limited number of bands in a well-planned manner.

As part of the progress diagnosis, this report also identifies remaining needs and suggests an agenda for satisfying those unmet spectrum needs of public safety agencies.

For further information regarding the original *Public Safety Spectrum Issues and Analysis Report* or to obtain a copy of that full report, contact the PSWN Program Office at P.O. Box 3926 Fairfax, VA 22038, (800) 565-PSWN, or www.pswn.gov.

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SUMMARY

The aggregate amount of radio spectrum allotted for public safety entities cannot satisfy existing day-to-day communications requirements or support interoperability requirements. The overall need for additional spectrum stems from enhanced mission requirements driven by population growth and numerous changes in demographics. In addition, the rise in domestic terrorism incidents, such as the Pentagon and World Trade Center, posed unique interoperability challenges because of the many responding public safety entities and time constraints. In 1993, the Congress became aware of this shortfall and directed the Federal Communications Commission (FCC) to study public safety spectrum needs and to develop a plan that ensured that adequate frequencies would be available for public safety uses through the year 2010.[1]

In 1995, the FCC adopted a Report and Plan regarding the then current and future needs of the public safety agencies through the year 2010. In the Report and Plan, the FCC properly concluded that it did not have the requisite information or entities involved to properly address the issue. The FCC and the National Telecommunications and Information Administration (NTIA) established the Public Safety Wireless Advisory Committee (PSWAC) to provide advice and assistance on this issue. Moreover, the FCC instituted a rulemaking proceeding whose overall goal was—

> …to develop the data necessary to evaluate the spectrum needs of public safety agencies, to solicit comment on how best to meet these needs, and to facilitate a transition to a communications environment in which public safety agencies have access to higher quality transmission, emerging technologies, broader services, including the ability to communicate readily with one another (interoperability).[2]

In September 1996, the PSWAC submitted its final report to the FCC and NTIA. The PSWAC report "sounded an alarm regarding the extent [to] which spectrum shortages are hampering the mission of safety and rescue personnel."[3] Based on the PSWAC recommendations, an additional 97.5 megahertz (MHz) of spectrum is needed by the year 2010 to meet public safety spectrum requirements. As the PSWAC Report clearly articulates, "in the short term (within 5 years) approximately 25 MHz of new public safety allocations were needed."[4] In order for interoperability to occur, 2.5 MHz of spectrum below 512 MHz should be designated. Another 70 MHz of general use spectrum would be required for voice, data, image, and video. These allocations would provide the public safety community a total of 145.05 MHz of radio spectrum.

In the Balanced Budget Act of 1997, the Congress committed an additional 24 MHz of the radio spectrum between 746–806 MHz (700 MHz band) to public safety services and the

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1 See *Omnibus Budget Reconciliation Act of 1993,* Pub. L. No. 103-66, Title VI, §6002, 107 Stat. 312 (codified 47 C.F.R § 309(j)(10)(B)(iv).

2 See *The Development of Operational, Technical, and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Agency Communications Requirements Through the Year 2010,* Notice of Proposed Rulemaking, WT Docket No. 96-86 (Rel. April 10, 1996)(WT Docket No. 96-86).

3 WT Docket 96-86, Second Notice of Proposed Rulemaking at 8.

4 See Public Safety Wireless Advisory Committee (PSWAC report) at 3.

remaining 36 MHz to commercial use.[5] The availability and use of this new spectrum is contingent upon the relocation of analog TV channels as part of the industry migration to digital television (DTV) and upon the availability of equipment.

Using the PSWAC report recommendations, the PSWN Program identified six issues whose resolution is essential to meeting the spectrum needs of the public safety community. The six issues are Aggregate Amount of Spectrum, Number and Appropriateness of Frequency Bands, Interoperability Spectrum, Multiband Technology, Spectrum Management Process, and Migration Strategy. Using these six issues as a baseline, this document will examine the progress of the public safety community toward reaching the goals set forth in the PSWAC Report. It should be noted that this document makes no judgements regarding decisions or events that have impacted this progress.

KEY FINDINGS

Although the need for additional spectrum has continually been articulated to regulators and the Congress, the amount of public safety spectrum has not significantly increased since the publication of the PSWAC Report in September 1996. The 24 MHz of spectrum in the 700 MHz band is still not available due to the slow migration of analog TV stations to DTV. Even if the spectrum were available, there is no public safety equipment that operates in this spectrum.

The following summarizes the actions that have been taken to support public safety spectrum requirements:

- 24 MHz of spectrum allotted in the 700 MHz band
- 150 kilohertz (kHz) of spectrum allotted in the 220-222 MHz band
- 312.5 kHz in the 150-174 MHz band and 425 kHz in the 406.1-470 MHz band designated for interoperability
- Trunked radio systems authorized below 512 MHz
- Shared use of public safety spectrum with federal agencies for joint communications systems
- Shared use of federal spectrum for implementation of a joint federal/non-federal communication system
- Electronic filing for applications for licenses

[5] See Section 337(a) of the Communications Act of 1934, as amended, 47 U.S.C. § 337(a), as amended by the Balanced Budget Act of 1997, § 3004.

Although actions have been taken to provide additional public safety spectrum, they have not been adequate to meet this critical need. In 1996, the PSWAC indicated that 25 MHz of spectrum was needed in five years; however, no spectrum is available to meet this immediate requirement. More states should assert themselves as leaders in efforts to obtain this spectrum resource which is needed nationwide. They and the rest of the public safety community should become more proactive in seeking additional spectrum through legislation and/or advocating their needs to regulatory agencies and the Congress. Public safety agencies should work with equipment manufacturers to ensure that equipment is available when the new 700 MHz spectrum can be used.

1. REPORT METHODOLOGY

The methodology employed to prepare this report began with a review of literature pertaining to the Public Safety Wireless Advisory Committee (PSWAC) recommendations. The specific publications reviewed included—

- *The Development of Operational, Technical, and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Agency Communications Requirements through the Year 2010, WT Docket No. 96-86*
- *Public Safety Wireless Advisory Committee Report*, September 1996
- *The Public Safety Spectrum Issues and Analysis Report,* December 1999
- *The Public Safety Radio Frequency Spectrum: Highlighting Current and Future Needs,* January 2000

This literature was reviewed and further researched. Special attention was paid to the regulatory initiatives involving the Federal Communications Commission (FCC) because of its broad role in public safety spectrum issues. The PSWAC report was the baseline for the data that was collected and analyzed during the research.

Each of the previously identified PSWAC recommendations and the actions taken to satisfy the recommendations were defined and analyzed. Once this was completed, recommended actions were proposed.

2. AGGREGATE AMOUNT OF SPECTRUM

The current aggregate amount of radio spectrum allotted for public safety entities cannot satisfy existing day-to-day communications requirements or support interoperability requirements. Most public safety agencies use spectrum to support voice communications. However, spectrum is also being used to support more advanced technologies such as data, imagery, and video transmissions. Additional spectrum is needed to address these shortfalls and to support the deployment of advanced technologies. Through legislation, the Congress has instructed the FCC that it must address the needs of the public safety community.

2.1 FCC Docket 96-86

In 1996, the FCC issued the first of five subsequent rulemaking proceedings regarding the management and use of the reallocated 24 MHz.[6] In September 1998, the FCC released its First Report & Order (R&O),[7] which established the rules governing the planning, management, and use of the general use spectrum. The R&O also created a band plan for the 700 MHz band whereby 12.6 MHz was designated as General Use spectrum, 2.6 MHz for Interoperability spectrum, and 8.8 MHz for Reserve spectrum. Subsequently, the FCC released the Third Memorandum Opinion and Order (MO&O) and Third R&O, [8] which designated 2.4 MHz of spectrum for state licensing and 24 narrowband channel pairs (0.3 MHz) for low power (2 watts effective radiated power) mobile operations only. The resultant band plan now designates 12.5 MHz for General Use, 2.6 MHz for Interoperability, 2.4 MHz for State License, 0.3 MHz for Low Power, and 6.2 MHz for Reserve.

The FCC also found strong support for national planning for both the Interoperability spectrum and the General Use spectrum for the 700 MHz band.[9] The FCC chartered the Public Safety National Coordination Committee (NCC), an advisory committee established under the auspices of the Federal Advisory Committee Act, to resolve certain issues related to the use of the 700 MHz band.[10]

Subsequently, the FCC adopted various technical and operational rules for the use of frequencies in the 764–776 MHz and 794–806 MHz bands designated for interoperability use.[11] The FCC believes that subsequent actions will facilitate the overall development and deployment of public safety equipment in the 700 MHz band without compromising the effective utilization of the spectrum.[12] The FCC also determined that the overall administrative and technical oversight involving Interoperability spectrum should be performed at the state level. The FCC will permit trunked operations on eight of the Interoperability channels on a secondary basis. In addition, the FCC adopted Project 25 Phase 1, a standard based on 12.5 kHz channels, as the

6 WT Docket 96-86.

7 WT Docket 96-86, First Report & Order, 14 FCC Rcd.

8 WT Docket 96-86, Third Memorandum Opinion and Order and Third Report and Order, (rel. October 10, 2000)

9 See First Report & Order, 14 FCC Rcd at ¶ 90.

10 *Id.* at ¶ 92. See Federal Advisory Committee Act, 5 U.S.C. App. 2 (1988).

11 See WT Docket 96-86, Fourth Report & Order and Fifth Notice of Proposed Rulemaking at 1.

12 *Id.* at 2.

voice and narrowband data standards for use on the 700 MHz band Interoperability channels. Moreover, the FCC deferred to the NCC final disposition of receiver standards for the 700 MHz band. Finally, in the Fifth Notice of Proposed Rulemaking (NPRM), the FCC sought comment on a migration path to 6.25 kHz technology for the 700 MHz band General Use channels.[13]

2.2 DTV Proceeding

The Balanced Budget Act of 1997 required the FCC to reallocate 24 MHz of spectrum in the 746–806 MHz band from television broadcasters to public safety.[14] In response, the FCC reallocated 24 MHz of television broadcast spectrum, television (TV) channels 63–64 (764–776 MHz) and TV channels 68–69 (794–806 MHz) to public safety. The transition is to occur by December 31, 2006. At present, the broadcasters have fallen behind the scheduled digital television (DTV) transition timeline for acquiring broadcast licenses in the top 10 and top 30 broadcast markets. The Balanced Budget Act of 1997 permits the FCC to extend the deadline to vacate the spectrum beyond 2006 if DTV penetration is below 85 percent or if digital to analog converter technology is not yet available in the market. Because the milestones have not yet been met, it is expected that the transition will not occur on schedule. If the transition is not completed on schedule, public safety users will be denied use of this spectrum beyond 2006. Moreover, in some cities, the public safety community may never have access to the 700 MHz band because of interference resulting from an inadequate separation distance between the city center and the TV transmitter.

In all likelihood, the transition to DTV will not occur by the year 2006. The public safety community will not gain access to this valuable 24 MHz allocation for many years, unless something proactive is done in the very near future. In a speech, then FCC Chairman William E. Kennard offered three viable legislative- and FCC-directed activities that would allow for the possibility of meeting the 2006 DTV deadline.[15] First, he suggested that the Congress should reconsider the 85 percent loophole on the 2006 date so that it could not be used as a "trick number" to justify making the double dose of spectrum a broadcaster entitlement for the next 25 years. Second, Mr. Kennard suggested that the Congress should direct the FCC to adopt requirements that all new television sets include the capability to receive the DTV signals. Third, he proposed that the Congress should require that, as of January 1, 2006, broadcasters pay a fee for the use of the analog channel. The public safety community should actively promote and support these resolutions both on Capitol Hill and at the FCC.

FCC Chairman Michael Powell created an FCC DTV Task Force to review the ongoing transition to DTV, and to make recommendations to the Commission concerning priorities to facilitate the transition and promote the rapid recovery of broadcast spectrum for other uses.[16] Chairman Powell commented that, "The DTV transition is a massive and complex undertaking. Although I'm often asked what the FCC is going to do to 'fix' the DTV transition, I believe that

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13 *Id* at 2.

14 *FCC Reallocates Television Channels 60–69 (746–806 MHz) to Other Services*, ET Docket No. 97-157, (rel. January 6, 1998).

15 See Remarks by Federal Communications Commission Chairman William E. Kennard to the Museum of Television and Radio (Oct. 10, 2000).

16 FCC News Release, re *Creation of FCC Digital Television Task Force*, (rel. October 11, 2001)

a big part of the problem were the unrealistic expectations set by the 2006 target date for return of the analog spectrum. This Task Force will help us re-examine the assumptions on which the Commission based its DTV policies, and give us the ability to react and make necessary adjustments." The Chairman added, "The second job of the Task Force will be to help us set priorities as we move forward – what we need to do immediately, what can wait, what need not be done at all, and what is more appropriately done by someone else because it involves aspects of the transition not within the purview or expertise of the FCC." He also cautioned that the Commission must review the DTV transition in light of "new realities that have arisen out of the tragic events of September 11." He said, "We must be aware of the financial impact of the attacks on our media companies. We must be aware of the impact on consumer spending. We must be aware of the needs of public safety and other wireless services for additional spectrum. Above all, we must be mindful of our place in the broader community."

To facilitate clearance of the 700 MHz band, the FCC has adopted rules to accommodate the implementation of voluntary band-clearing agreements among incumbent broadcasters and new licensees in the band.[17] However, unless the public safety community reaches out on this issue, there is a strong likelihood that the 2006 date will be missed and this most valuable spectrum will not be acquired for years to come.

2.3 Other FCC Proceedings

In a separate proceeding, the FCC designated spectrum in the 220-222 MHz band for public safety use[18] to facilitate public safety communications. This spectrum is available to local, state, and federal public safety entities. Fifteen channel pairs (30 frequencies), measuring 5 kHz wide, provide an additional 150 kHz of spectrum designated for public safety entities. Ten of the channels are available to public safety for base/mobile operations. The remaining five channels are available for licensing for emergency medical services use only.

In its 700 MHz First R&O,[19] the FCC adopted service rules for commercial operations on the 747–762 MHz and 777–792 MHz bands that followed the previously adopted base/mobile designations governing operations in the adjacent public safety frequency bands. In a subsequent MO&O,[20] the FCC responded to several Petitions for Reconsideration of the 700 MHz First R&O. In the 700 MHz First R&O, the FCC modified Section 27.50 of its rules to enable both base and mobile station transmitters to transmit on both the 747-762 MHz and 777–792 MHz bands. The FCC ruled that revision of Section 27.50 broadened the range of technologies and potential services represented in the auction process, better enabling the market to evaluate the

17 WT Docket 99-168, CS Docket 98-120, MM Docket 00-39, *Order on Reconsideration of the Third Report & Order*, (rel. September 17, 2001

18 See *Filing Freeze To Be Lifted for Applications Under Part 90 for the Fifteen Public Safety Channel Pairs in the 220–222 MHz Band*, DA 97-2296, (rel. Feb. 13, 1998).

19 See *Service Rules for the 746–764 and 776–794 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, WT Docket No. 99-168, First Report and Order, 15 FCC Rcd 476 (2000). See also Erratum, 15 FCC Rcd 8634 (2000); Errata, DA 00-2094, (rel. Sept. 14, 2000).

20 See *Service Rules for the 746–764 and 776–794 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, WT Docket No. 99-168, *Carriage of the Transmissions of Digital Television Broadcast Stations*, CS Docket No. 98-120, *Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television*, MM Docket No. 00-39, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, FCC 00-224, (rel. June 30, 2000).

benefits of the services and not causing any additional interference with public safety radio operations. In addition, the modification allowed licensees to configure their systems to avoid any potential interference with mobile receivers operating in the lower block frequencies from television broadcast stations transmitting on adjacent channels. Subsequently, Motorola filed a Petition for Reconsideration in this proceeding.[21] Motorola took issue with the FCC's decision to modify its rules to allow base station operations in both the upper and lower commercial bands on the grounds that the rule modification would result in objectionable interference from base station transmitters in the commercial 777–792 MHz band with public safety base station receivers operating in the nearby 794–806 MHz block. The FCC disagreed with Motorola's assertion and found that public safety base stations within 4.8 kilometers of a commercial base station would not experience interference.[22] However, the PSWN Program recently filed a separate Petition for Reconsideration on this issue. In its petition, the program urged the FCC to defer establishing the proposed changes to Section 27.50 until sufficient technical evaluation could be completed and considered.

The FCC responded to the PSWAC recommendation that electronic filing for licenses be streamlined by adopting rules that implemented the Universal Licensing System (ULS), an integrated database and automated processing system.

The implementation of trunked radio systems typically increases spectrum efficiency. Trunking is the commonly accepted term for electronically controlled sharing of a relatively small number of communications channels among a relatively large number of users. (See PSWN Report *Comparisons of Conventional and Trunked Systems*, May 1999.) To promote more efficient use of the limited spectrum resource, the FCC adopted rules that permit the operation of trunked systems below 512 MHz. However, very few trunked systems have been installed because of the large number of existing conventional radio systems currently installed.

In the winter of 2000, the FCC instituted a proceeding regarding the 4.9 gigahertz (GHz) band.[23] The Omnibus Budget Reconciliation Act of 1993[24] required the Secretary of Commerce to identify 200 MHz of Federal Government allotted spectrum for transfer to the private sector. The 200 MHz of spectrum that was to be recommended for reallocation was required to be located below 5 GHz, with at least 100 MHz of spectrum below 3 GHz. On February 29, 2000, the FCC released an NPRM to allocate and establish licensing and service rules for the 4940–4990 MHz (4.9 GHz) band that was transferred from the Federal Government. The FCC proposed to license the band under Part 27 of its rules.[25] It also proposed that the initial licenses for the 4.9 GHz band be acquired through competitive bidding under Part 1 of its rules.[26] The Federal Law Enforcement Wireless Users Group (FLEWUG) submitted comments requesting

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21 See *Service Rules for the 746–764 and 776–794 MHz Bands, and Revisions to Part 27 of the Commission's Rules,* Second Memorandum Opinion and Order, WT Docket No: 99-168 (rel. Jan. 12, 2001).

22 *Id.* at 3.

23 See *The 4.9 GHz Band Transferred from Federal Government Use,* Notice of Proposed Rulemaking, WT Docket No. 00-32 (rel. Feb. 29, 2000).

24 *Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, 107 Stat.312 (1993).*

25 *47 C.F.R. Part 27.*

26 *47 C.F.R. Part 1.*

that if the currently scheduled auction of the 4.9 GHz band did not prove commercially viable, the FCC should consider allocating a portion of the 4.9 GHz band for public safety.

2.4 Conclusion

The reallocation of 24 MHz does not begin to meet the existing and future telecommunications needs of the public safety community. As the PSWAC report indicated in 1996, 25 MHz of spectrum was needed in 5 years, and an additional 70 MHz of general use spectrum would be required by 2010. The public safety community has not acquired any additional spectrum since the completion of the 1999 *Public Safety Spectrum Issues and Analysis Report*. At the present time public safety has only acquired 49 percent of the total spectrum (145.05 MHz) that the PSWAC concluded was necessary to support public safety operations. Further, delays in the implementation of DTV are likely to prevent public safety from using valuable spectrum in the future.

The PSWAC report identified several bands as potential allocations for public safety: 1710–1755 MHz—wideband data and video, 1990–2110 MHz—microwave or wideband data/video requirements, and 4635–4685 MHz (subsequently changed to 4940–4990 MHz) — point-to-point systems or short-range mobile video systems. These bands are no longer available because they were reallocated for other uses or will be auctioned off to commercial services.

Due to increased demands for spectrum to support advanced wireless systems, including third generation (3G) as well as future generations of wireless systems, the public safety community needs to become more proactive in seeking additional spectrum through legislation and/or advocating its needs before the FCC.

3. NUMBER AND APPROPRIATENESS OF FREQUENCY BANDS

Public safety spectrum is fragmented into discrete portions of radio spectrum throughout the very high frequency (VHF) and ultra high frequency (UHF) bands. Local, state, and federal public safety operations are spread across the frequency bands shown in Table 1.[27]

Table 1
Current Distribution of Frequency Bands

Local and State Bands (MHz)	Federal Bands (MHz)
25–50	30–50
72–76	138–150.8
150–174	162–174
220–222	220–222
450–470	406.1–420
470–512	
764–776 and 794–806	
806–821 and 851–866	
821–824 and 866–869	

Almost half of the channels available for use by public safety entities are located in the high-band UHF range, with the second most available channels in the high band VHF range.

Frequency band fragmentation causes interoperability problems among local, state, and federal public safety entities and impedes joint public safety operations. Users in different bands are unable to communicate with each other, thus isolating different disciplines and jurisdictions from one another. The public safety community has implemented methods to meet the interoperability challenges caused by frequency band fragmentation by swapping radios, equipping personnel with multiple radios, equipping personnel with expensive dual-band radios, and installing multiband repeaters.

The public safety spectrum should be located across a minimum number of frequency bands, and these bands should be appropriate for supporting public safety communication requirements. The feasibility of migrating to one public safety band is not realistic because of the intense competition among commercial, private, and government users for available bands. When the FCC allocates spectrum it should take into account the public safety community's needs. However, not all spectrum is suitable for these needs. The technical characteristics of potential bands must be evaluated to ensure that they are suitable for future public safety use.

The PSWAC report identified certain frequency bands that would consolidate public safety voice communications and narrowband data communications in or near current public safety bands. The 174–216 MHz band was specified as a band that should be immediately

[27] The distribution of channels includes the 24 MHz allocated in the 700 MHz band; without these channels, the distribution would be as follows: low-band VHF (25–50 MHz)—15.83%; low-band VHF (72–76 MHz)—0.34%; high-band VHF (150–174 MHz)—33.44%; high-band VHF (220–222 MHz)—1.02%; low-band UHF (406.1–420 MHz)—18.49%; low-band UHF (450–512 MHz)—20.64%; and high-band UHF (806–869 MHz)—10.24%.

shared, outside of urban areas, for statewide public safety systems. In addition, the PSWAC recommended that public safety users be permitted to share unused TV channels in the 470–512 MHz band. However, these proposals are no longer feasible because the bands are being used for DTV. The public safety spectrum in the 700 MHz band is adjacent to the existing 800 MHz spectrum, resulting in a concentration of public safety users in these bands. Many state and local public safety entities are migrating to the 800 MHz band. In addition, the adjacent 700 MHz band increases the number of allotments of public safety channels by an additional 2,160 channels. Thus, the 700 MHz and 800 MHz bands are emerging as the primary public safety bands for the state and local public safety community. However, the current spectrum above 700 MHz does not resolve existing frequency band fragmentation or technical obstacles. Although the 700 MHz spectrum is adjacent to the 800 MHz spectrum, the benefits of contiguous bands still cannot be realized for several reasons. At this time no mobile, portable, or base station land mobile radio (LMR) equipment operates in the 700 MHz band. In addition, no public safety equipment is readily available that can support both bands.

3.1 Conclusion

The allotment of the 700 MHz band further compounds the problem of the number of frequency bands where public safety agencies are located. The feasibility of migrating public safety users to fewer blocks of spectrum is not realistic, especially with the competing spectrum demands of commercial wireless service providers. Also there is a need to maintain different propagation characteristics for different public safety missions and the cost of replacing the embedded base of public safety radio equipment would be insurmountable.

4. INTEROPERABILITY

An insufficient amount of spectrum has been dedicated to meet the public safety community's interoperability requirements. Interoperability spectrum is required in all public safety bands to support multidisciplinary, multijurisdictional operations for day-to-day response, mutual-aid response, and specialized task forces.[28] Nearly 90 percent of local fire and emergency medical services (EMS) agencies surveyed indicate the need to interoperate with other local public safety organizations on a daily or weekly basis.[29] Roughly 93 percent of all law enforcement agencies interoperate with local organizations, while 63 percent interoperate with state organizations, and 15 percent interoperate with federal organizations.[30]

To improve interoperability, many areas of the country have designated regionwide channels to support their interoperability requirements. In some instances, states have established statewide interoperability channels for law enforcement, fire, and EMS. These channels are generally found in the high-band VHF range and in the 800 MHz band, and only provide interoperability among users operating in the same band in a particular region.

4.1 FCC/NTIA Actions

The public safety community has acquired additional interoperability spectrum for public safety bands. The FCC recognized the need for adequate amounts of interoperability spectrum for public safety communications and designated 2.6 MHz of the 700 MHz band for interoperability purposes. The 128 narrowband and 36 wideband channels can be used for voice, data, image/high-speed data (HSD), and video transmissions. The interoperability spectrum is authorized on a nationwide basis and accounts for 10.8 percent of the total 700 MHz band allocation. The FCC also authorized federal agencies with public safety missions to have co-equal access to the new spectrum, implementation of which will facilitate shared system development. Implementation of shared local, state, and federal communications systems will resolve many interoperability problems and maximize the use of available funds. Making federal users eligible for co-equal access to the 700 MHz spectrum creates an environment in which multijurisdictional interoperability can occur.

Additional developments have taken place beyond the allocation of the new 700 MHz spectrum. The PSWAC report recommended an additional 2.5 MHz of spectrum below 512 MHz to support interoperability requirements. The NTIA authorized the use of 20 frequencies in the 162–174 MHz band and 20 additional frequencies in the 406.1–420 MHz band to provide interoperability for joint local, state, and federal law enforcement operations and for public safety communications during disasters and emergencies. The FCC is continuing to designate channels in existing public safety bands for mutual-aid purposes (i.e., five frequencies

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[28] Day-to-day responses involve coordination during routine public safety operations. Mutual-aid responses involve a joint and immediate response to an incident and require tactical communications among groups of public safety personnel. Task force operations involve local, state, or federal agencies coming together for an extended time period to address a public safety challenge.

[29] *PSWN Program Analysis of Fire and EMS Communications Interoperability*, December 1998.

[30] National Institute of Justice. *State and Local Law Enforcement Wireless Communications and Interoperability: A Quantitative Analysis, January 1998.*

in the 150–162 MHz band and four channel pairs in the 450–512 MHz band). The FCC also designated frequencies in the VHF Maritime band in each of the thirty-three inland VHF Public Coast areas.[31] However, only the interoperability frequencies in the Maritime band are authorized for wideband (25 kHz) operations. The remaining new VHF and UHF frequencies that have been authorized for public safety interoperability can only be used on narrowband equipment and are not available in most areas of the country. The implementation of narrowband systems should be tracked to determine when and where the interoperable frequencies should be used.

Common technology standards are also needed to support interoperability between public safety agencies. The NTIA has been an active supporter of the Project 25 (P25) process, a joint effort of local, state, and federal governments, with support from the U.S. Telecommunications Industry Association (TIA). The primary objectives of the P25 standards process are to provide high quality digital, narrowband radios that meet all public safety user needs, and to permit maximum interoperability. Secondary objectives include obtaining maximum radio spectrum efficiency, ensuring competition throughout the life of systems, and ensuring that equipment is user friendly. Although developed in the United States, P25 standards were designed for the global marketplace. P25 radios can be produced for any VHF or UHF band. The standards developed by P25 Phase One have been adopted by TIA and are referred to as TIA-102.

The NTIA and the PSWN Program are actively participating in the Project MESA (Mobility for Emergency and Safety Applications) initiative. Project MESA is a project between the TIA and the European Telecommunications Standards Institute to develop specifications for mobile broadband services which will serve the future public safety needs of citizens in North America and in the European Union.

A national strategy to coordinate FCC and NTIA actions is needed to establish a comprehensive plan for the management of interoperability spectrum. Under this strategy, the FCC and the NTIA would pool, coordinate, and jointly manage public safety interoperability spectrum. This, in turn, would create a collaborative environment, promote the use of the spectrum, and ease the development of interoperable radio systems. A joint approach would reaffirm the commitment of the FCC and the NTIA to address the unmet spectrum requirements essential for achieving interoperability throughout the Nation.

Establishment of joint rules for public safety interoperability spectrum should be considered to ensure a consistent approach for obtaining and maintaining assignments, securing approvals for system plans, and validating use of the spectrum for interoperability purposes. In addition, joint rules would help create a single, unified set of procedures for using interoperability spectrum by all public safety entities. Moreover, joint rules would create an administratively efficient environment for system developers to obtain and maintain interoperability frequencies.

31 WT 96-86, *Third Memorandum Opinion & Order and Third Report & Order*, (rel. October 10, 2000)

4.2 The NCC

To advise on optimum use of the interoperability spectrum in the 700 MHz band, the FCC established the NCC to—

- Formulate an operational plan to achieve nationwide interoperability that includes a shared or priority system for both day-to-day and emergency operations, including federal users' access to the interoperability spectrum
- Recommend interoperability digital modulation, trunking, and receiver standards
- Offer voluntary assistance in the development of coordinated regional plans
- Provide recommendations on other technical matters that are common to the public safety community.

On February 25, 2000, the NCC submitted its first report to the FCC, describing the participants in the NCC's decision-making process, the meetings the NCC conducted, and the exchanges of information that occurred in developing the recommendations. On August 2, 2000, the FCC released its Fourth NPRM, which sought comment on the NCC report. The subsequent Fourth R&O stated that the overall administrative and technical oversight involving Interoperability spectrum should be performed at the state level. Determinations were also made regarding certain operational requirements for use of the 700 MHz band spectrum, such as channel designation and access priority. In addition, the FCC would permit trunked operations on eight of the Interoperability channels on a secondary basis. It also adopted Project 25 Phase 1, a standard based on 12.5 kHz channels, as the voice and narrowband data standards for use in the 700 MHz band Interoperability channels. The FCC determined that equipment designed exclusively for voice communications was not required to be data capable. Similarly, equipment designed exclusively for data applications was not required to be voice capable. In addition, licensees could employ encryption on any interoperability channel except the two calling channels, provided that they used the encryption standard specified by the FCC. Moreover, the FCC deferred to the NCC final disposition of receiver standards for the 700 MHz band.

The FCC also endorsed the NCC recommendation that each state should form a State Interoperability Executive Committee (SIEC) to administer the Interoperability channels.[32] Among their duties, the SIECs would develop interoperability operational plans. If an SIEC or another agency elected not to oversee development of such plans for a state, then the Regional Planning Committee would perform that function. The FCC supported the idea of an SIEC; however, it declined to force creation of an SIEC in every state. It said it believed that a voluntary framework allowed each state to determine its own requirements and best approach.

32 See Fourth Report & Order at 6.

4.3 138–144 MHz Band

Title III of the Balanced Budget Act of 1997 required the Secretary of Commerce to provide from spectrum currently allocated for federal use an aggregate amount of at least 20 MHz below 3 GHz for allocation and assignment by the FCC. Among the proposed transferred spectrum was 3 MHz in the 138–144 MHz band. The National Defense Authorization Act for Fiscal Year 2000 reclaimed the 3 MHz in the 138–144 MHz band for use by the Department of Defense (DoD). The National Defense Authorization Act for Fiscal Year 2001 requires the Secretary of Defense, in consultation with the Attorney General and the Secretary of Commerce, to provide a report to the Senate and House Armed Services Committees to identify– (1) any portion of the 138-144 MHz band that can be shared in various geographic regions with public safety radio services; (2) any measures required to prevent harmful interference between DoD systems and the public safety systems proposed for operation on those frequencies; and (3) a reasonable schedule for implementation of such sharing of frequencies. The Act also requires the Secretary of Commerce and the Chairman of the FCC to submit a report to Congress on alternative frequencies available for use by public safety systems. This report is to be submitted by January 1, 2002.

Public safety agencies in many metropolitan areas along the Canadian and Mexican borders require the use of the new spectrum today to meet their daily requirements. The existing frequency coordination agreements with Canada and Mexico must be modified to ensure the new spectrum can be made available to meet these needs. In this regard, the DoD is actively involved in ongoing negotiations between the United States and the Mexican government for sharing the 138–144 MHz band along the border. Until bilateral negotiations with Mexico and Canada and the DoD sharing study are completed, the DoD is unable to identify any portion of the 138–144 MHz band for sharing.

4.4 Conclusion

There is still a need for additional public safety spectrum for interoperability purposes below 512 MHz. The public safety community should continually remind lawmakers and the FCC that spectrum in all public safety bands is still required for interoperability.

The FCC and NTIA should investigate the feasibility for designation of mandatory standards for use on all interoperability spectrum.

5. MULTIBAND TECHNOLOGY

In the current environment, public safety agencies operate across many different frequency bands, making interoperability among users difficult. In many instances, users must carry multiple radios or communicate through a third party (i.e., dispatch center) to interoperate with agencies using in different frequency bands. Thus, the probability of migrating to one public safety band, regardless of the practicality or desirability of doing so, is low because the system architectures and equipment that support multiband communications are not readily available from many vendors. However, although there is significant interest by users in equipment capable of operating across multiple frequency bands, most manufacturers do not provide equipment that enables multiband communications using a single radio. Many equipment manufacturers do not believe that there is a significant demand in the public safety LMR market for multiband equipment. Thus, they do not produce many types of multiband equipment nor do they invest in research and development for new multiband technologies.

Multiband systems are considerably more expensive than single-band systems due to dramatically higher secondary costs for designing the system. These costs include, but are not limited to, the following:

- Engineering costs—Complicated engineering studies must be performed to design systems to operate across multiple bands (i.e., coverage area concerns).

- Planning costs—An increase in system planning costs is expected because multiple agencies must coordinate budgets, operations, and procedures.

Therefore, the costs associated with developing multiband technology may limit manufacturers' efforts in this area.

Moreover, the physical characteristics of a single radio that operates across multiple frequency bands may preclude its utility for public safety use. Multiband radios are often larger and bulkier than typical single-band radios, making them less portable. In addition, extensive testing and evaluation in this market is largely dependent upon the vendor community. Vendor testing may not be reflective of real-life scenarios faced by the public safety community. No testbeds are being built or demonstrations undertaken to develop equipment specifications.

5.1 Conclusion

The FCC has issued rules that streamline equipment authorization procedures to promote the implementation of software defined radio (SDR) technology.[33] Federal agencies are also exploring the use of SDR technology to provide interoperability because SDR radios can be tuned to operate in many frequency bands. Although this technology has the potential to resolve many interoperability problems, it likely will not be available for public safety use for many years.

[33] ET 00-47, First Report & Order, (rel. September 14, 2001)

The PSWN Program should continue to fully evaluate the current state of multiband technologies (e.g., equipment options, price ranges, and engineering requirements). This would help members of the community become more aware of multiband technologies and allow for additional alternatives for system planners to use in meeting their short-term and long-term goals. The PSWN Program should continue to draw on its understanding of multiband technologies to develop recommendations on ways these technologies could provide a potential solution to meet interoperability and spectrum requirements in shared system situations.

The PSWN Program should also help to create visible demand for multiband technologies. The program should continue to hold forums and focus groups to educate members of the public safety community on ways multiband technologies could help satisfy existing communications requirements. In addition, the PSWN Program should continue to coordinate and pool resources of local, state, and federal public safety entities to explore the possibility of large-scale procurement of multiband radios. The community could use this new understanding to influence or encourage the vendor community to develop affordable multiband technology.

Further, the PSWN Program should perform pilot tests and demonstrations using multiband equipment that works across public safety bands to evaluate performance and features that best meet the needs of the public safety community.

6. SPECTRUM MANAGEMENT RULES

The processes by which spectrum is allocated, assigned, and administered for public safety use can appear complex to most system managers and users. The state and local processes and regulations are contained in Part 90 of the *Code of Federal Regulations*; federal processes and regulations are contained in the NTIA *Manual of Regulations and Procedures for Federal Radio Frequency Management.* These documents are cumbersome and not very user friendly, which presents a challenge to public safety users trying to understand the rules, regulations, and processes that govern their spectrum use.

6.1 The Role of the FCC and NTIA

Coordination between the FCC and NTIA to specifically address interoperability among public safety entities is insufficient. Currently, there is no overarching national strategy for the management of public safety interoperability spectrum. Following the submission of the PSWAC Report, the Public Safety Communications Joint Working Group was formed to coordinate public safety issues between the FCC and the NTIA. Among the participants were the PSWN Program and members of the FLEWUG. The joint working group was responsible for enhancing cooperation and the exchange of information between the FCC and the NTIA and coordinating their efforts in addressing the recommendations of the PSWAC. However, this Working Group is no longer in existence. The sharing of federal and non-federal public safety frequencies is not well established and is generally handled on a case-by-case basis by both the FCC and NTIA. Separate advisory committees have been established for various bands (i.e., 700 MHz Regional Planning Committees, 800 MHz Regional Planning Committees), potentially increasing the difficulty of coordinating spectrum management between these bands. Moreover, multiple spectrum management processes and rules apply, depending on the frequency band, leading to fragmented management, difficulties in establishing interoperability across multiple bands or with multiple licensees, and obstacles to sharing spectrum.

Spectrum management processes should be better understood and should evolve to encourage interoperability and the efficient use of spectrum. User-friendly information regarding spectrum management processes should be readily accessible to the community to promote a better understanding of the FCC and NTIA regulations and procedures. A thorough understanding of the regulatory processes will increase the efficiency and speed with which users navigate through the frequency assignment processes. Moreover, an understanding of spectrum management processes is essential to developing strategic positions and useful recommendations regarding improving the regulatory environment.

Extensive coordination between the FCC and the NTIA is needed to ensure spectrum management processes meet the growing demands of public safety communications and encourage interoperability of local, state, and federal public safety agencies. Both the FCC and the NTIA have recognized the need to make more efficient use of resources, both spectrum and money. To promote interoperability between local, state, and federal agencies, the NTIA authorized the use of federal spectrum for the implementation of a shared trunked radio system for the State of Wisconsin. The FCC has adopted rules that permit public safety licensees to

share their facilities with Federal Government entities on a non-profit, cost-shared basis.[34] Common rules allowing shared, joint use of federal and non-federal spectrum will promote establishment of shared systems among local, state, and federal public safety entities. Alignment of spectrum management processes would allow for greater flexibility for the public safety community in terms of the types of communications supported, the kinds of technologies used, and the system solutions implemented.

6.2 Conclusion

To effectively use existing spectrum and funding resources, extensive coordination is needed between the FCC and NTIA to ensure that spectrum management rules allow for establishing shared systems and for creating an efficient environment for system developers to obtain and maintain interoperability frequencies. The Public Safety Joint Working Group should be re-established to address public safety issues.

34 See Third Memorandum Opinion and Order and Third Report and Order

7. MIGRATION STRATEGY

A well-planned strategy to migrate public safety operations to a limited number of bands and to implement new technologies should be flexible enough to take into account the different local, regional, or national operational needs of the user community. Any effective migration strategy must involve a coordinated, nationwide effort to manage public safety communications. Coordinated national planning will reduce fragmented management of public safety spectrum while preventing the proliferation of a variety of incompatible systems. In an environment focused on shared infrastructure, it is necessary to have the participation of federal public safety agencies in any coordination effort. Moreover, a process for ongoing evaluations of implementation efforts relative to this strategy will also be essential to ensure that development efforts are consistent with plans. The plan should be consistent with the current FCC and NTIA rules.

The migration strategy should be promoted to gain the support of major public safety entities. To be successful, any migration strategy must be widely accepted by associations, programs, and entities that have influence throughout the public safety community (e.g., the International Association of Fire Chiefs, the International Association of Chiefs of Police [IACP], the National League of Cities, and the PSWN Program). Further, the migration strategy must have champions at all levels of government that are willing to keep the process moving forward.

7.1 FCC/NTIA Actions

In the Fourth NPRM, the FCC declined to adopt specific rules until it sought further comment on the migration to 6.25 kHz standard on the 700 MHz band General Use channels. Based on the comments it received in the Fourth NPRM, the FCC divided the implementation proposals for the 6.25 kHz standard for General Use channels into two groups. The first group contended that there is no need for migration at all on the General Use channels.[35] The second group proposed a migration path consisting of five stages and an implementation timeline of 21 years.[36] The PSWN Program again reiterated its longstanding support for migration to the 6.25 kHz standard on the 700 MHz band General Use channels.

The PSWN Program concurred with the majority of commenters in this proceeding in supporting the Association of Public-Safety Communications Officials International, Inc. (APCO) migration plan.[37] As the FCC clearly articulated in the Fifth NPRM, the five-step APCO plan is based on a 21-year implementation period.[38] Under Step One of the APCO migration plan, the immediate adoption of Project 25 Phase I, as the interoperability standard is necessary. Step two requires that as of December 31, 2006, or within six months following

35 See generally Com-Net Ericsson, Nokia, and North American TETRA Forum (NATF) comments to the Fourth NPRM.

36 See generally APCO, IACP, Motorola, FLEWUG, PSWN Program, and Project 25 Steering Committee comments to the Fourth NPRM.

37 See generally comments of APCO, the PSWN Program, Motorola, State of California, and the FLEWUG to the Fifth NPRM.

38 Fifth NPRM at ¶ 97.

Commission notice that at least fifteen of the Top twenty metropolitan areas have been cleared of relevant television stations, whichever is later, all newly type-accepted radios for use in the band must have the capability to provide one voice channel per 6.25 kHz and must still meet the Project 25 Phase I standard for the Interoperability channels. Step Three of the APCO plan requires that within 10 years after Step Two, all General Use operations must be at 6.25 kHz in the top 50 metropolitan areas. Further, Step Four of the APCO plan requires that General Use operations must be at 6.25 kHz for the rest of the Nation within 15 years after Step Two. Finally, under Step Five, as of the date established in Step Two, the FCC must reexamine the technological marketplace and determine whether to develop a subsequent migration path

Recognizing the need to make more efficient use of existing spectrum, the NTIA requires that all new federal agency communications systems in the bands 162-174 MHz and 406.1-420 MHz be capable of operating within a 12.5 kHz channel. By January 1, 2005, all systems in the 162-174 MHz band must be capable of operating within a 12.5 kHz channel. By January 1, 2008, all systems in the 138-150.8 MHz and 406.1-420 MHz bands must operate within a 12.5 kHz channel. Time Division Multiple Access systems, with at least one voice channel per 12.5 kHz, are also allowed.

The FCC requires that applications for part 90 certification of transmitters designed to operate on frequencies in the 150-174 MHz and/or 421-512 MHz bands, received on or after February 14, 1997, must include a certification that the equipment meets a spectrum efficiency standard of one voice channel per 12.5 kHz of channel bandwidth. Applications for certification received on or after January 1, 2005, except for hand-held transmitters with an output power of two watts or less, will only be granted for equipment with the following channel bandwidths:

> (a) 6.25 kHz or less for single bandwidth mode equipment;
> (b) 12.5 kHz for multi-bandwidth mode equipment with a maximum channel bandwidth of 12.5 kHz if it is capable of operating on channels of 6.25 kHz or less;
> (c) 25 kHz for multi-bandwidth mode equipment with a maximum channel bandwidth of 25 kHz if it is capable of operating on channels of 6.25 kHz or less; and
> (d) Up to 25 kHz if the equipment meets the efficiency standard of one voice channel per 6.25 kHz of channel bandwidth.

Applications for part 90 certification of transmitters designed to operate on frequencies in the 150-174 MHz and/or 421-512 MHz bands, received on or after January 1, 2005, must include a certification that the equipment meets a spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth.

7.2 Conclusion

The PSWN Program and FLEWUG believe that migration to the General Use channels in the 700 MHz band must occur in a stepped process such as that proposed by APCO and that such a migration is dependent on a number of variables. One of these variables, as the FCC correctly points out, is the status of the DTV transition. Because the public safety community has a personal stake in the 24 MHz of spectrum being vacated by TV broadcasters, it depends on the FCC to help facilitate completion of the transition by 2006.

The NTIA has mandated a migration path for implementation of new technologies that promotes increased spectrum efficiency. This path will provide the spectrum required for the additional communications requirements of the federal agencies. Although the FCC has implemented rules to promote spectrum efficiency through the equipment certification process, incentives should be developed and provided to persuade public safety agencies to migrate to new spectrum-efficient technologies.

8. CONCLUSIONS AND RECOMMENDATIONS

Although some actions have been taken to address the recommendations of the PSWAC, the public safety agencies still have the same spectrum requirements as they did in 1996. The spectrum that was reallocated from the TV broadcast bands is still not available. Even if it were, there is no equipment available for use in the 700 MHz band.

While the 24 MHz of new spectrum allocation is acknowledged as a positive step within the public safety community, it has only addressed a fraction of the spectrum needs identified by the PSWAC Report, which recommended that the Commission provide a total of 97.5 MHz of additional spectrum for public safety services to meet the current and foreseeable requirements for wireless communications through the year 2010. This means that a total of 73.5 MHz of spectrum is still needed. Approximately 71 MHz is still required to meet the need for emerging high-speed data and video applications, while the remaining 2.5 MHz is required for interoperability below 512 MHz.

The number one priority of the public safety community must be to obtain the additional spectrum that the PSWAC report identified as essential for public safety to perform its mission in the future. However, spectrum allocation is a heated and politically charged issue. If the public safety community does not take a more proactive role, it may find itself without the needed spectrum to properly perform its essential duties in the future. Because of the amount of revenue realized through the auctioning of valuable spectrum, the Congress may push aside the needs of public safety in favor of the fiscal benefits of auctioning spectrum to private industry. Therefore, a comprehensive proactive program is needed now to ensure that public safety obtains the spectrum needed to save lives and protect property.

Federal and non-federal agencies with public safety missions should explore the feasibility of implementing shared communications systems. Shared systems enhance interoperability communications and can result in more efficient use of spectrum and monetary resources.

SDR technology may resolve many of the interoperability problems caused due to the number of frequency bands used by public safety. The PSWN Program should continue to evaluate the feasibility of SDR technology for use by the public safety community.

The Public Safety Joint Working Group should be re-established to coordinate local, state, federal, and tribal public safety issues.

Recognizing that common standards promote interoperable communications, the FCC designated the Project 25 standard for the interoperable spectrum in the 700 MHz band. The FCC and NTIA should continue to explore the requirement for technical standards to promote interoperability in all public safety frequency bands and to resolve radio frequency interference problems.

APPENDIX A—ACRONYMS

3G	Third Generation
APCO	Association of Public-Safety Communications Officials International, Inc
DoD	Department of Defense
DTV	Digital Television
EMS	Emergency Medical Services
FCC	Federal Communications Commission
FLEWUG	Federal Law Enforcement Wireless Users Group
GHz	Gighahertz
HSD	High Speed Data
IACP	International Association of Chiefs of Police
kHz	Kilohertz
LMR	Land Mobile Radio
MHz	Megahertz
MO&O	Memorandum Opinion and Order
NCC	National Coordination Committee
NPRM	Notice of Proposed Rulemaking
NTIA	National Telecommunications and Information Administration
P25	Project 25
PSWAC	Public Safety Wireless Advisory Committee
PSWN	Public Safety Wireless Network
R&O	Report & Order
SDR	Software Defined Radio
SIEC	State Interoperability Executive Committee
TV	Television
UHF	Ultra High Frequency
ULS	Universal Licensing System
VHF	Very High Frequency